



Institute of High Energy Physics
Chinese Academy of Sciences

Weekly Report

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Pointnet++ on CEPC calorimeter

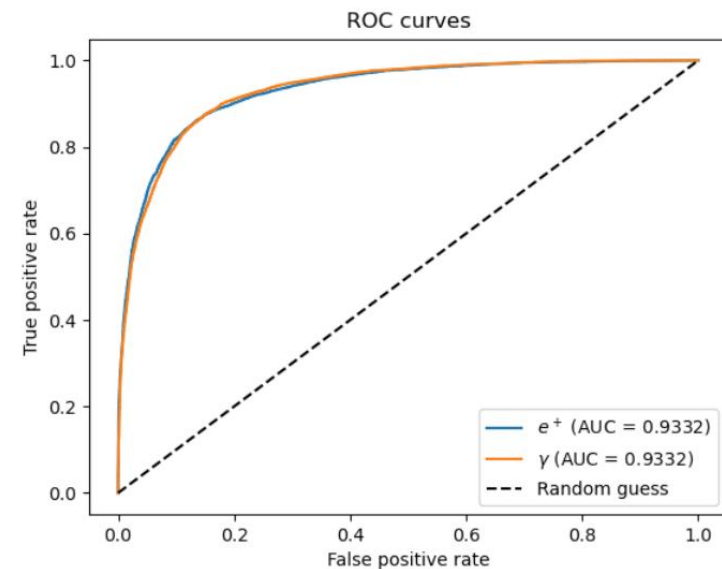
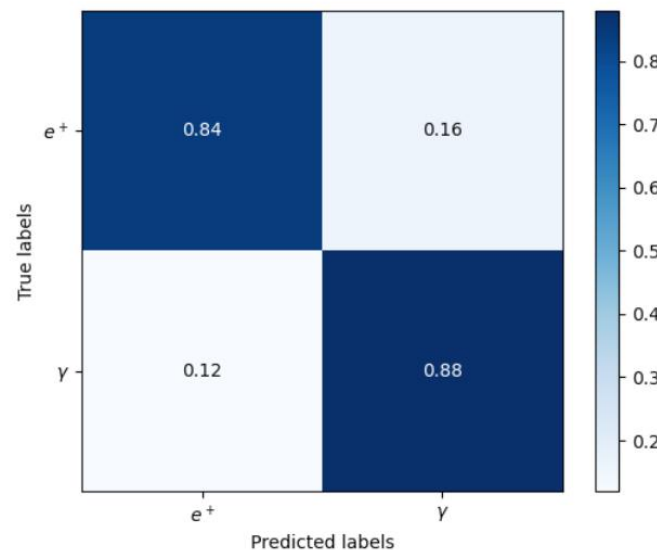
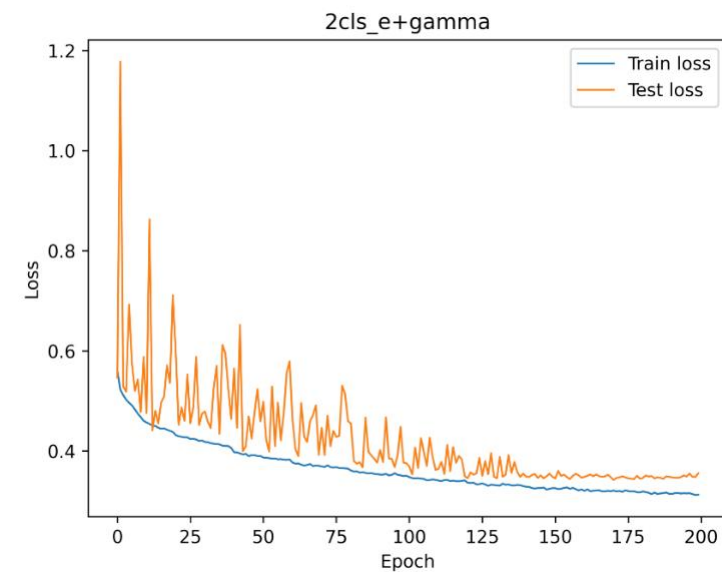
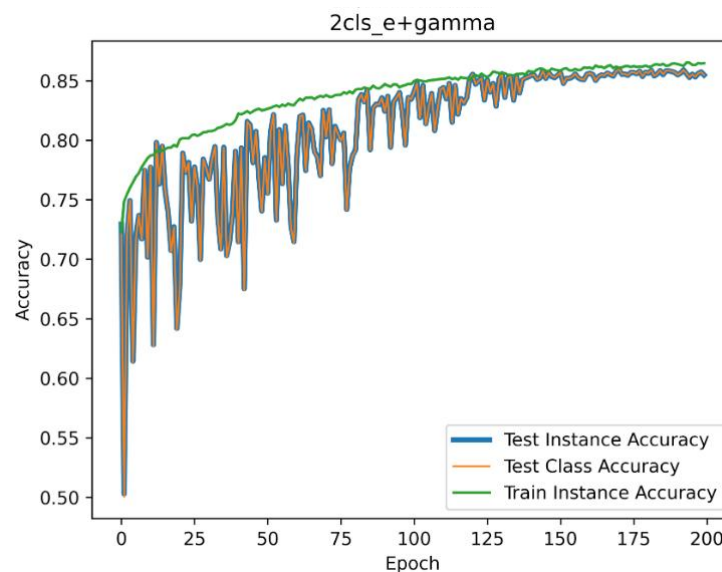
➤ 2-category classification $e^+ \gamma$

datasize=5w+5w

batchsize=256

epoch=200

feature: x,y,z



Pointnet++ on CEPC calorimeter

➤ 2-category classification $e^+ \gamma$

Sp: Sphericity

$$S^{\alpha, \beta} = \frac{\sum_i p_i^\alpha p_i^\beta}{\sum_i |\vec{p}_i|^2}$$

By the standard diagonalization of $S^{\alpha, \beta}$ one may find three eigenvalues $\lambda_1 \geq \lambda_2 \geq \lambda_3$, with $\lambda_1 + \lambda_2 + \lambda_3 = 1$.

$$S = \frac{3}{2}(\lambda_2 + \lambda_3).$$

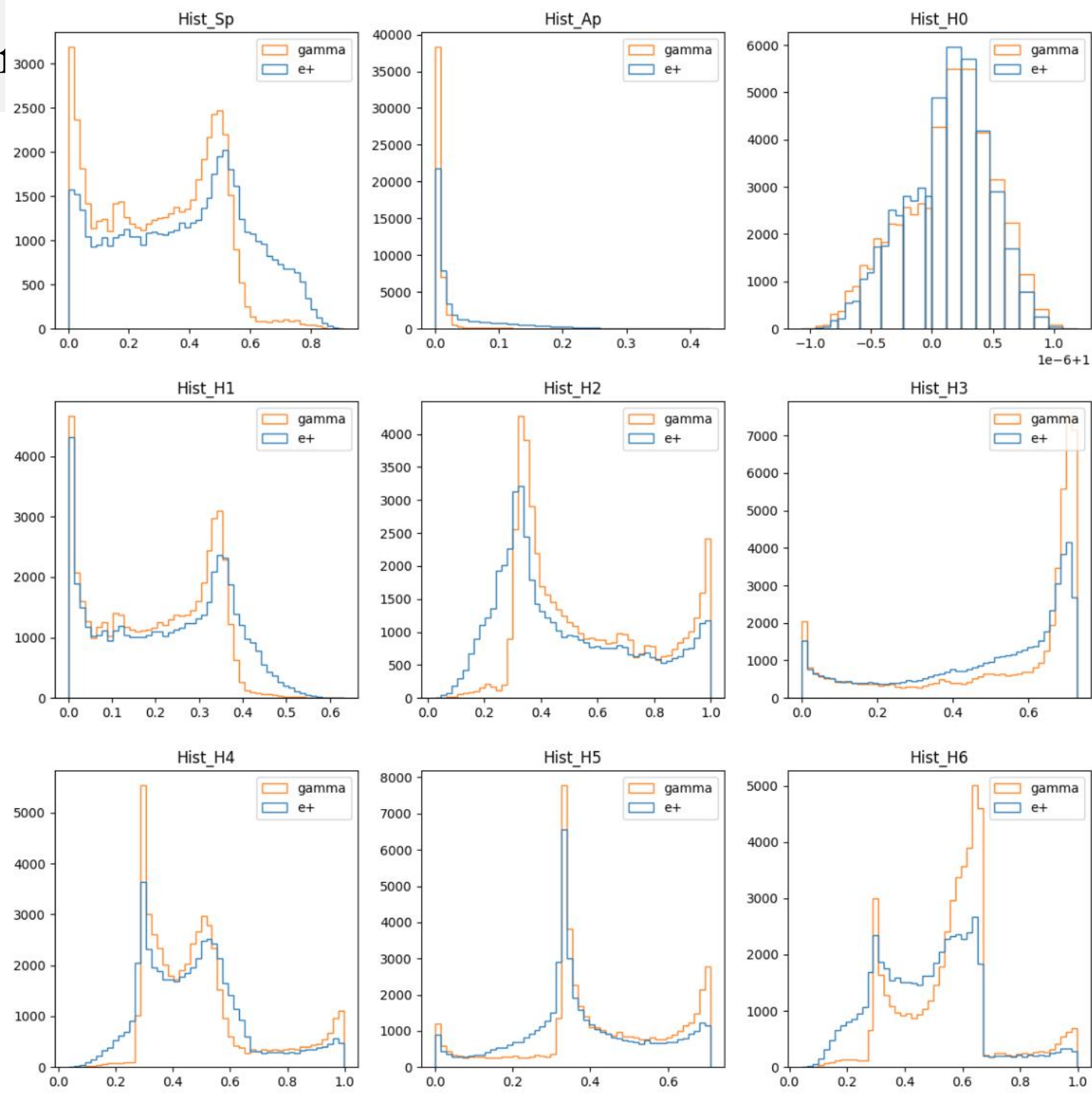
Ap: Aplanarity

$$A = \frac{3\lambda_3}{2}$$

Fox-Wolfram moments:

$$H_l = \sum_{i,j} \frac{|\vec{p}_i| |\vec{p}_j|}{\boxed{E^2}} P_l(\cos \theta_{ij})$$

replaced by P



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```
#loop entry/shower
for j in range(len(data)):
    # if (j)%100==0:
    #     print("evt:", j)
    hitx = data[j][:, 0]
    hity = data[j][:, 1]
    hitz = data[j][:, 2]
    hitx_av = np.sum(hitx)/len(data[j])
    hity_av = np.sum(hity)/len(data[j])
    hitz_av = np.sum(hitz)/len(data[j])
    Px = hitx - hitx_av
    Py = hity - hity_av
    Pz = hitz - hitz_av

    P = np.sqrt(Px**2+Py**2+Pz**2)
    # print(type(P))
    Energy = np.sum(P)
```

How to process “E” in a shower?

There're many points in a shower with information x,y,z,E,T
But E is deposited energy and the points have no energy information.

Center of the shower: (hitx_av, hity_av, hitz_av)

The distance from each point to the center point is taken as the **momentum value**.

All momentum added up is considered as the shower's **energy**.

The plan of this week:

- 1) To draw the shape variable **Thrust** (defined as the direction which maximizes the sum of the longitudinal momenta of the energy clusters).
- 2) To finish coding the reconstruction efficiency of 2-track events and draw some figs.